LUMINAIRE LEVEL LIGHTING CONTROLS
TECHNOLOGY FOCUS
Talking Points

Keywords: Electric Lighting, Advanced Lighting Controls, Networked Lighting Controls, Luminaire-Level Controls, Controls, Energy Savings, LLLCs

A luminaire-level lighting control system can realize significant energy and maintenance savings and help boost employee satisfaction

- The installed lighting power density (LPD) went from 0.97 W/ft2 to a post-retrofit LPD of 0.44 W/ft2, a decrease of 55% due to the switch from fluorescents to LED fixtures. Including the LED wattage reduction and operational savings from the advanced wireless controls, energy savings totaled around 69% (Wei et. al., 2015).

- Savings from occupancy sensors relative to automated schedules were found to be around 22%, with an additional 10% coming from institutional tuning, and another 7% from daylight harvesting (even though daylighting was only implemented on about one-third of the fixtures in the study group (Wei et. al., 2015).

- Overall comfort level with the light levels doubled from pre- to post-retrofit conditions (even with the reduction in average illuminance), with more occupants also feeling like work surfaces were evenly lit (Wei et. al., 2015).

- This comprehensive meta-analysis provides strong evidence that lighting controls do on average capture significant energy savings—between one-quarter and one-third of lighting electric energy, depending on the individual control strategy, and up to nearly 40% for buildings in which multiple controls strategies are used (Williams et. al., 2011).

- The 1:1 retrofit solutions ranged from 50% to 74% savings, and the redesign solution showed 67% savings. These savings numbers do not include savings from the LED upgrade (Mahić et. al., 2020).

- The occupants were overall more satisfied with the function of the automatic controls installed with the new system showing satisfaction rates going from an average of 72% to 84% (Richman & McIntosh, 2018).

- The after LED fixture and after tuning bars represent the reduction in maximum lighting power with new LED fixtures and light levels adjusted to occupant needs. The LPD reduction across all zones going from fluorescent to LED lighting is 53% (0.86 W/ft2 to 0.41 W/ft2) of the original lighting power (Myer, 2018).

- For all office zones combined, the total annual energy use intensity (EUI) savings of 2.41 kWh/ft2 (3.50–1.09) represents a 69% overall reduction in lighting energy use (Myer, 2018).

- 45% of the savings resulted from a combination of improved lighting efficiency (LED) and significant light-level reductions (up to 76%) supported in part by a reduction in total light fixtures (Myer, 2018).

- A recent study of field data from over 100 installations found that networked lighting controls save an average of 47% energy, not including energy savings from switching to LED light source (Shackelford et. al., 2020).

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- Integrated building systems retrofits have been shown to increase savings over single end-use retrofits. One study found 30% whole building energy savings from component retrofits, but over 80% savings for integrated systems retrofits (Shackelford et. al., 2020).

- Savings ranged from around 20% for the system with daylight dimming and automated shading controls, but no source change savings (fluorescent to LED), to over 70% savings for retrofit packages that included source change to LEDs with advanced controls and either shading system changes (venetian blinds to mechanical roller shades with daylight redirecting blinds) or lighting layout improvements (workstation-specific lighting design) (Shackelford et. al., 2020).

- With a delay time of 20 min and not grouping the troffers, LLLCs with wide fields of view reduce energy use by 40% compared with the base case, resulting in electricity cost savings of US$6.20 per year per troffer. LLLCs with narrow fields of view reduce energy use by 48% compared with the base case, resulting in electricity cost savings of US$7.50 per year per troffer (Snyder, 2020).

- Reducing the delay period time from 20 min (a typical default value) to 5 min reduces energy use by an additional 14% for the wide field of view and by an additional 21% for the narrow field of view relative to the 20-min-delay energy use, providing an additional electricity cost savings of US$1.40 to US$2.70 per year per troffer (Snyder, 2020).

- The results show that when LLLCs are grouped into pairs, energy use is increased by 10% for the wide field of view and by 18% for the narrow field of view compared with ungrouped LLLCs (Snyder, 2020).

- The scenario leading to the least energy use (narrow field of view, 1-min delay period, ungrouped, turn off when unoccupied) uses 35% of the base case (manual switches) energy use, while the scenario leading to the most energy use (wide field of view, 20-min delay period, nominal groups of 8, turning off during vacancy) uses 75% of the base case energy, more than double the lowest energy use case (Snyder, 2020).

- The energy cost savings ranged from $6.20 for an ungrouped wide-field-of-view LLLC with a 20-min delay to $9.10 for an ungrouped narrow-field-of-view LLLC with a 5-min delay (Snyder, 2020).

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Personal control of an individual's lighting system leads to higher satisfaction and typically a reduction in energy consumption

- Based on the meta-analysis, the best estimates of average energy savings potential are 24% for occupancy, 28% for daylighting, 31% for personal tuning, 36% for institutional tuning, and 38% for multiple approaches (Williams et. al., 2011).
- Additionally, participants rated higher sense of alertness for LLLC 1:1 solutions, higher satisfaction with the amount of light at the workstation for paper- and computer-based tasks, and higher rating of lighting distribution at the workstation (Mahić et. al., 2020).
- Task Tuning can provide a large opportunity for energy savings, often greater than occupancy and daylight harvesting (Richman & McIntosh, 2018).
- Advanced control systems can provide a more uniform and smoother transition from occupied to unoccupied lighting levels and back again, promoting better quality lighting for work environments along with granular sensing and automatic-on features (Richman & McIntosh, 2018).

Luminaire-level lighting controls simplifies code compliance and promotes future technological integration

- Advanced wireless lighting control systems currently available are meant to simplify the installation process for lighting controls, potentially reducing material and labor costs by negating the need for long runs of controls and communication wiring (Wei et. al., 2015).
- Cost-effectiveness results for new construction and major renovation scenarios, with the much lower incremental installed project costs (close to $1/ft2), are much better. With paybacks ranging from 3 to 6 years, adding wireless advanced lighting controls to lighting projects is a compelling opportunity in new construction and major renovation (Wei et. al., 2015).
- The lighting market started out focusing on energy savings, but it's evolving quickly towards non-energy applications, Hedayat said. Other non-energy applications Digital Lumens is considering: security, fire and safety, asset tracking, and humidity (Davidson, 2016).
- Tracking occupancy 'gave me the ability to consolidate product that is picked more often than others,' he said. 'And rather than having people going from one side of the warehouse to the other, I can consolidate all of the busy products into a small number of aisles so all of the activity is in the same area' (Davidson, 2016).
- LLLC systems are a cost-competitive 1:1 retrofit alternative that provide comparable performance to more comprehensive NLC redesign solutions (Mahić et. al., 2020).

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